AGRICULTURAL Research

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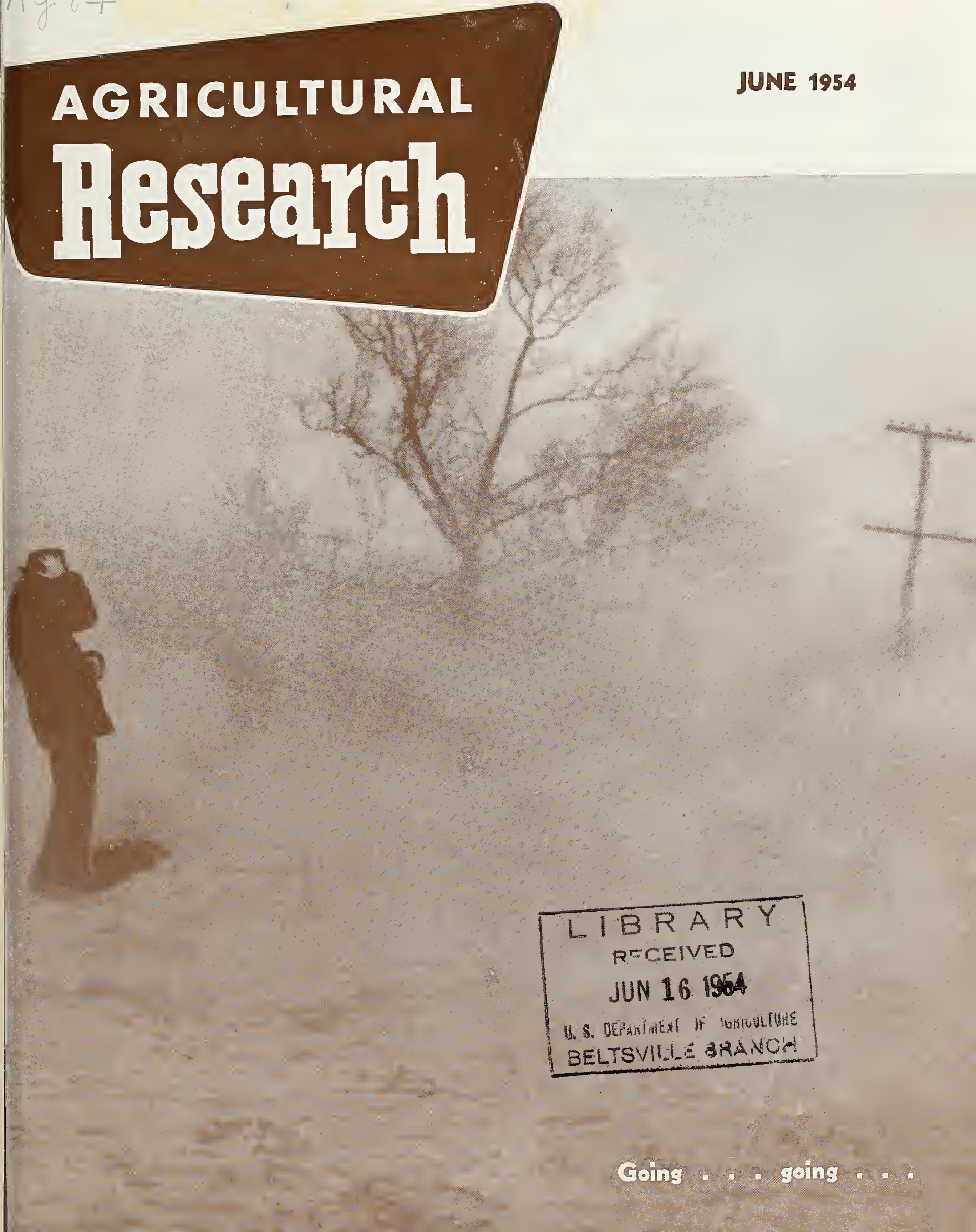

Going . . . going . . .

AGRICULTURAL Research

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JOSEPH F. SILBAUGH—MANAGING EDITOR

Solving for X

Into research go curiosity, thought, trial. We can't demand a certain number of findings a day—as from a factory line. Nor can teams promise to solve problems in a year—as in a contract for a building.

Often, researchers battle forward step by step, year after year, against a baffling disease. The poultry scourge lymphomatosis, for example, is giving ground in this grudging way (story on p. 4).

That's the sort of thing we expect. So it's only natural that we feel some elation over the remarkable conquest of X-disease of cattle.

This relatively new disorder is often fatal, especially to calves. Once well on its way, there's no known means of halting or curing it. First recognized in 1941, it was called X-disease—X for the unknown. (The keratinized or horny layer that develops on skin of the neck, shoulders, and withers later gave rise to the name hyperkeratosis.)

Nobody knew what caused X-disease or whether it could be treated and cured. Treatments were tried, including large doses of sulfa drugs and penicillin and massive doses of vitamins. They had no effect.

By October 1948, X-disease had been reported in 32 States and was causing a loss in cattle estimated at $2 to $4 million a year.

In June 1949, ARS animal pathologist A. M. Lee was put in charge of coordinating X-disease research in several States. During the next year, researchers failed in hundreds of attempts to produce this disease—and they had to be able to produce it in order to identify it.

Practically the whole environment of the affected cattle had to be studied—soils, plant life, fertilizers, livestock feeds, and so on. When animals receiving pelleted feeds began to get X-disease, the search shifted to methods of pelleting and to the lubricants used.

A lead from a German scientist and months of hard work by researchers in many States brought the answer: highly chlorinated naphthalene—a wax used by manufacturers to lend body to certain greases and oils.

Most lubricant makers have now volunteered to avoid using this chemical in lubricants likely to reach farms. Researchers are checking other possible causes and looking for methods of treatment.

Symptoms, preventive measures, and the research story are told in new USDA Leaflet 355, "Hyperkeratosis (X-Disease) of Cattle."

AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

NATURE REVOLTS against bare-land farming. Mulch is a good soil-holder but has its faults. Scientists hope to overcome them and unlock the potentialities of mulch farming (story p. 10).

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DAIRY

Producing GOOD MILK at low cost

HIGH-QUALITY milk can be produced with less than half the labor commonly used and with approximately half the investment commonly found in farm dairy buildings, according to results of a 3-year case study conducted on several farms in the St. Louis milk shed.

This study was initiated by USDA and conducted under contract with the Doane Agricultural Service, Inc., St. Louis, Mo. Representatives of the Illinois and Missouri experiment stations also helped develop work plans. The study sought answers to two major questions:

1. How do dairy buildings and equipment influence milk quality?

2. What's the most economical investment in labor, buildings, and equipment consistent with the production of high-quality milk?

In answer to the first question, the study strikingly revealed that production of good milk—once established by effective sanitation and cooling—isn't adversely affected by use of low-cost buildings, labor-saving arrangements, or increases in herd size. Sanitation was achieved by such established practices as cleaning cows properly, cooling milk promptly and adequately, and using chemicals and mechanical means for cleaning and maintaining equipment.

Answers to the second question were found in employment of the loose housing system of dairy farming, better arrangement of buildings, and use of equipment designed to increase efficiency. New construction or remodeling was provided on test farms at a cost, based on 1950 prices, of about $200 per cow for the new dairy buildings and equipment needed for herds of 20 to 30 cows. This is little more than half the reproduction cost of conventional buildings and facilities commonly found on farms producing Grade A milk in the area.

Nine ordinary farms in the St. Louis milk shed were used for the test. Operators of some of them had not previously attempted to produce milk of a quality suitable for direct fluid consumption. New buildings and equipment were installed step by step on three of the test farms. Buildings were extensively remodeled on four. On the remaining farms, two complete dairy systems were constructed at the beginning of the study.

Four additional farms on which Grade A milk was already being produced were used as controls.

Operators who followed recommended sanitation practices and used effective cooling systems produced milk of sufficiently low bacterial count to meet Grade A standards.

On one test farm, for example, a change from hand milking to pipeline milking and from no mechanical cooling to spray cooling reduced bacteria count from above 500,000 per milliliter in 50 percent of the samples to an acceptable level of 200,000 or less. In fact, the proportion of samples that tested under 20,000 bacterial count per milliliter on this farm compared favorably with that on one of the better control farms.

Labor studies indicated that as many as 225 hours per cow per year were spent on some of the experimental farms in the first year of the study. The average for 6 of the farms was about 155 hours. Changes made for the sake of efficiency reduced this chore labor to an average of about 58 hours per cow per year in the final months of the study.

Labor efficiency was improved mainly through ground-level storage of hay and silage, self feeding, and direct movement of feed from storage to feeders; elevated stalls and means of bringing cows to the operator; rest-area arrangement and storage of bedding to reduce quantity used and labor involved; and use of a pipeline milker, spray cooler, water heater, and similar dairy equipment.

Other contributing factors were work routines to keep milker units in nearly constant operation at milking time and use of a preparation stall, in addition to two milking stalls, to get cows ready for milking.

Belief that loose-housing systems of dairy farming require large quantities of bedding was disproved by the study. Over a 3-year period on one of the farms, for example, only 475 pounds of bedding was used per cow per year. This was accomplished largely by eliminating cow traffic lanes and by feeding hay and silage at convenient distances from the resting area. From 35 to 50 square feet of space was available in the resting area and the cows were kept clean without difficulty.☆

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Lymphomatosis

POULTRY'S WORST DISEASE

IN A SMALL laboratory in Michigan, scientists are waging war against the most defiant and deadly enemy of poultry. This enemy is lymphomatosis—the disease that is to chickens what cancer is to man.

The poultry industry is watching every move, every step forward. Victory will help producers save the $75 million a year they now lose in this disease. Medical scientists are following the work for leads in fighting human cancer.

Lymphomatosis is a penalty of progress. Although it existed years ago, it caused little trouble until our poultry industry began to use modern production methods. Forced-draft incubators, mass brooding, and interstate shipments of chicks were ideal for spreading the disease.

In the early twenties, poultrymen began reporting strangely sick chickens. Some victims had paralyzed legs or wings. Many had pale or bluish combs and wattles, others grayish eyes. Some flocks were hit harder than others; none was immune. Deaths ran 5 to 50 percent.

These symptoms were typical of the three known types of lymphomatosis. It attacks the nerves (neural type), the internal organs (visceral type), or the eyes (ocular type).

By the late thirties, scientists and farmers in the big poultry States saw the need for an all-out attack on lymphomatosis. They asked USDA to take the lead. The Department responded in 1939 by establishing the Regional Poultry Research Laboratory at East Lansing, in cooperation with 25 north central and northeastern State experiment stations.

Scientists there have been using every available resource to conquer this disease, which *in 1 week* costs poultrymen nearly as much as the *entire cost* of building and operating the laboratory these 15 years.

The scientists are slowly gaining ground. Let's look at these gains.

First, we've learned that lymphomatosis is an infectious, contagious, malignant disease, caused by filterable virus. Researchers haven't isolated the virus, but they've transmitted the disease to chicks by inoculating them with filtered extracts of blood, tissues, and secretions or excretions from infected birds.

In addition to the three forms of lymphomatosis, there are several related diseases. One called osteopetrosis or marble bone causes enlargement and hardening of the long bones. Another affects the blood-cell-forming tissues in the bone marrow. A number of leukemic forms attack the red and white corpuscles.

All these conditions, together, are called the avian-leukosis complex. Whether they're all caused by a single virus is not yet known. The fact that investigators at one laboratory often can't verify results at another suggests they may be dealing with different viruses.

Second, the scientists know that lymphomatosis is transmitted through the egg from hen to chick, and by contact—direct or indirect.

When research began at the laboratory in 1939, only eggs were brought in. The chicks were hatched and reared in new, quarantined buildings. Yet, within 6 weeks after hatching, lymphomatosis appeared.

In 1950, infectious bronchitis broke out among the laboratory flocks. All chickens and eggs were destroyed, except for some breeding stock that was salvaged and taken to a new isolated location on the premises. Buildings were left vacant several months and were scrubbed and disinfected before more eggs were hatched. Nevertheless, lymphomatosis reappeared within a short time.

Except for this one outbreak of bronchitis and some coccidiosis, the flocks have been entirely free of diseases and parasites. But the stringent measures that produced this unprecedented health record haven't prevented lymphomatosis.

Direct transmission experiments were also conducted. G. E. Cottral and coworkers inoculated groups of day-old chicks with filtered extracts of liver tissue from embryos and from newly hatched chicks. Both embryos and donor chicks were apparently normal and were from clinically normal parents. After 300 days there were many more cases of visceral lymphomatosis among the inoculated

chicks than among the controls. These experiments showed that the virus was present in the embryo, circulating blood, and day-old offspring of some hens. Hence, clinically normal birds may carry the disease and transmit it through the egg.

Tests just completed show conclusively that lymphomatosis is spread by contact in hatching and brooding. B. R. Burmester and R. F. Gentry inoculated day-old chicks with oral-nasal washings and with extracts of feces from infected chicks. Both produced visceral lymphomatosis.

Chicks that had been inoculated when young shed the virus in their feces as adults, even though they were clinically normal. This was further proof that clinically normal birds may carry the disease.

Another interesting fact came to light: extract of infected feces failed to produce the disease when mixed with an extract of feces from normal chickens. Apparently, feces of normal noninoculated birds contains something that inactivates the virus in infected feces.

Third, the scientists have reduced—but not eliminated—the incidence of lymphomatosis by hatching and brooding chicks in isolation. Experiments by N. F. Waters and J. H. Bywaters showed fewer cases in chicks exposed after 30 days than among those exposed earlier. Isolation and quarantine measures followed at the laboratory, however, wouldn't be practical on most poultry farms.

Fourth, the researchers found that some chick lines or strains are much more lymphomatosis-resistant than others. By intensively inbreeding White Leghorns for 14 years, Waters has obtained both susceptible and resistant lines. The most resistant line shows about 10 percent mortality from lymphomatosis, the most susceptible line about 50 percent.

Attempts thus far to prevent or treat lymphomatosis with vitamins, hormones, antibiotics, and vaccines have failed. So have efforts to develop serological tests that would detect the virus in clinically normal chickens. Such a test would be invaluable in finding carrier birds so they could be removed from a flock, thus eliminating transmission of the disease through the egg.

Logical questions at this point are: Where do we go from here? What are the greatest obstacles?

Scientists at the laboratory say one of their greatest handicaps is lack of birds known to be free of lymphomatosis virus. Results can't be measured with confidence if experimental chicks may already be infected.

To develop unquestionably free stock would require that eggs from individual hens be hatched separately and the chicks rigidly quarantined for 600 days or longer. If a single chick showed infection, the entire lot would have to be discarded—until one family was found that lived for a long period free of the disease. From this family a lymphomatosis-free population would be developed.

Another difficulty is the long period before the disease is fatal or even recognizable and the relatively few birds that get sick at any one time. In this respect, lymphomatosis is unique among poultry virus diseases. (Chickenpox, for example, usually affects a whole flock within 2 weeks.) The time factor could be partly overcome by running a number of experiments simultaneously. This, of course, would take extra facilities.

Director Berley Winton emphasizes that scientists at the laboratory and cooperating stations aren't discouraged. They point to the years of research and education required to stop pullorum disease. and to the progress now being made against polio. They feel much as scientists working on human cancer do—given the resources, they will one day conquer poultry's most dread disease.☆

VISCERAL lymphomatosis (big-liver disease) is biggest killer, hardest to detect. Pale or bluish comb or wattles and rundown appearance are symptoms but not certain indication. Enlarged, tumorous liver (left) is sure sign. The other liver came from a normal chicken.

NEURAL lymphomatosis (fowl or range paralysis) is second biggest killer, easiest to detect. Legs, wings, neck become paralyzed, causing unsteady gait, inability to walk, or drooping wings. Post-mortem shows nerves enlarged, discolored tannish gray to brown.

OCULAR lymphomatosis attacks eyes, often causes blindness. Irises lose color, appear gray or light tan. Pupils become restricted, often distorted, don't dilate at death. This form of lymphomatosis is sometimes called iritis, pearly eye, fishy eye, or gray eye.

INTERNATIONAL COOPERATION among these countries is doing much to improve crops around the world (see story). Not one of our major crops is native to the United States, so plant introduction is an old story for this country (AGR. RES., July 1953, p. 8). But now the plant materials we export for testing and possible adaptation to foreign growing conditions far overbalance the materials we introduce for domestic use. Such cooperation is enabling foreign countries to slash years from their breeding research programs in many instances.

International cooperation

IS IMPROVING OUR CROPS

SOUTH AMERICAN farmers have encountered races of crown rust that attack oat varieties resistant to all races present in North America. So, to be prepared should these races appear in the United States, oat varieties and breeding materials have been included in the International Rust Nurseries of South America. Some have proved resistant to the crown rust races present there.

This is just one example of how agricultural-research time is being telescoped today by international cooperation. There are many others.

COTTON. In cooperation with the National Cotton Council and the Mexican government, USDA started winter cotton plantings at Iguala, Mexico, in 1950–51. This is speeding up our hybrid program by enabling breeders to grow two generations a year. Plantings in this isolated valley have helped both our institutional and private breeders get more rapid increase of desired seed and also have speeded competitive yield tests.

BARLEY. Valuable information on disease resistance and other characteristics of some 5,000 varieties in the world collection has been obtained by growing them in Canada, Mexico, Colombia, and Egypt, as well as several locations in the United States. Plant breeders make extensive use of the data in selecting parents.

POTATOES. Fifteen of our best-producing potato varieties were sent to Greece for breeders to plant and study. Two varieties proved more productive than any historically grown there. Greek breeders immediately requested additional seed of these varieties and hope to increase Greece's potato production significantly.

CORN. Uniform tests of United States hybrids were started in 19 countries of Western Europe and the Mediterranean region in 1948. Some were found to be adapted and are now widely grown.

Higher yields obtained from hybrids have enabled corn to compete

with other crops in Belgium. The Netherlands, where corn acreage historically has been quite small, has increased its acreage appreciably. In Italy, 8.7 percent of the corn acreage in 1952 was in hybrids and in France, 15 percent. Work on hybrids is now being pursued in a dozen or more European countries, and hybrids developed there have been included in these uniform tests since 1952.

How has all this coordinated international research come about?

It started in a small way, right after World War I, with wheat. USDA and State experiment station cereal-crop researchers sought a system for coordinating their efforts to develop improved, disease-resistant varieties. They worked out a plan for uniform nurseries in which wheat seed of promising strains from all the States would be distributed on a regional basis for uniform testing.

Primarily, the researchers were trying to develop stem-rust resistance, but they also were concerned with leaf rust, mildew, and other diseases. The effort became international when Canada expressed interest in 1928. Intensive study of quality, reaction to disease, and other characteristics of test strains became possible as data were collected uniformly under different conditions.

Scope of the work broadened in the middle and late 1940's when Mexico entered the group. It became more extensive in 1950 with establishment of the International Rust Nursery by breeders and pathologists in South America and countries already active in the work. This is simply an enlargement of the "nursery"already existing; the same seed is used by all the countries participating. But a greater mass of data is being uniformly obtained and exchanged. The nursery carries an average of 600 to 1,000 lines of wheat.

The International Rust Nursery has grown in the last couple of years to where wheat strains are tested for resistance to races of rust and under the environments of most wheat-growing countries in the world.

The value of this cooperation, from its development domestically to its growth internationally, has already been demonstrated. By 1938 the United States had stem rust under control in the spring-wheat areas. When race 15B struck in 1950, Kentana, a highly resistant variety, was already on the increase in Mexico. Parents resistant to race 15B had been brought into the breeding program in the United States and Canada.

PICKING cotton at Mexican station, researcher places seed of each plant in a separate bag. New hybrids are among materials under test for our breeders.

Unfortunately, Kentana proved partially susceptible to an old strain of stem rust, race 49. But the new Selkirk variety, developed by the Canadians, is being released this year. And another new one called Willet, produced by the Minnesota experiment station in cooperation with USDA, will be available for 1955.

Other promising rust-resistant material is under test. So it seems likely that some additional resistant wheat varieties will probably be released in another year or two.

Though this is promising, growers are warned against expecting "too much, too soon." Research in developing new varieties of wheat can't be restricted to disease resistance. Other characteristics such as resistance to lodging, grain quality, and high productivity must be developed, too. All this takes time.☆

RESISTANCE TO LODGING is one of many qualities researchers look for in wheat in these Mexican test fields. Cooperation with Mexico has greatly advanced breeding. Two crops are made yearly and growing conditions are perfect to test breeding stocks, including 13,000 wheats collected over the last 50 years, for stem-rust resistance.

Light

LINK IN TOMATO

EVER WONDER why off-season market tomatoes are often pink instead of the rich-orange-red of garden fruit? USDA plant physiologists A. A. Piringer and P. H. Heinze found the answer recently as they added a new link to the chain of mysterious ways in which *light* regulates plants (AGR. RES., May–June, July 1953).

It takes light to bring out a yellow pigment in the wax-like skin of the tomato. Through a yellow skin, the red flesh underneath looks orange. But through a colorless skin—market fruit ripened in dark rooms doesn't develop the yellow pigment—the flesh looks pink.

The scientists discovered that light acts on tomatoes much as in a number of other plant responses:

1. *Red* light is the most effective region of the spectrum in producing this yellow pigment—just as red is most effective in promoting the germination of lettuce seed and preventing the flowering of cocklebur.

2. Exposing tomatoes to the longer waves of barely visible *far-red* light *undoes* the effect of the red, keeping the skin colorless—just as far-red also prevents the germination of lettuce seed and promotes the flowering of cocklebur. Repeated reversals can be made.

Related responses have been found in onion bulbing, strawberry runner production, and root formation on corn seedlings. But this change in tomato skin color is a reaction that takes place right at the point where the light's applied. By covering most of a tomato to keep out light, the effect can even be held to one spot.

A little light is all it takes: 5/100 of a foot candle—a little brighter than moonlight—for an hour a day during the ripening period of 10 to 14 days. Light starts to act as soon as fruits mature. The first 5 days of ripening are the critical period—after that it's too late for light to bring out any color in the skin.

The coloring substance appears to be one of the flavonoids, yellow pigments found in many plants. (Rutin, a drug from green buckwheat, is one of the best known.)

Piringer and Heinze believe this flavonoid comes from living cells just below the tomato's skin. But the way the light works isn't yet clear—it may have something to do with the formation of the pigment, or with its movement out to the skin, or with both processes.

If a tomato variety contains the pigment, it responds to light regardless of ripening temperature. Piringer and Heinze emphasize that this flavonoid is a *result* of light treatment—*not* the substance that *picks up* the light. Special light-active molecules of plant pigment are believed to be involved in such responses.

This discovery may not be used commercially since it would be costly to light tomatoes and turn them for uniform exposure in ripening rooms. But we're a step nearer to understanding how light regulates plant life.☆

How to grow more *Alfalfa* on the desert

Scientists have made the Arizona desert produce over 12 tons of alfalfa per acre, per year, by using ample phosphorus and keeping the soil moist with frequent irrigations.

This yield in a 4-year experiment on the Yuma Mesa is over four times the State average. Yet it took only a fifth more water than most ranchers use. Yuma gets less than 2½ inches of rainfall per year.

The big gain came from applying 500 pounds of P_2O_5—a fertilizer that stays in the upper 18 inches of soil—and keeping the soil moist to a depth of 3 feet. With fertilizer, moisture, and root activity centered in this zone, the crop thrived on the rich supply of phosphorus.

The desert soil has relatively little natural phosphorus and that scant amount is so scattered and so slowly available that plants must reach deep for it. Even with ample moisture, their growth falls far short of the attainable 12-plus tons.

Phosphorus was applied at various times and in amounts ranging from 100 to 1,300 pounds of P_2O_5 per acre. Only the largest application gave a bigger yield—¼ ton more hay per acre per year—than the 500-pound treatment. A plot given 600 pounds of P_2O_5, all of it at seeding time, and 2 plots given 700 pounds, apportioned among the 4 test years, yielded nearly as well. But at each phosphorus level, yield increased as the number of irrigations increased.

Soil scientist C. O. Stansberry, now in charge of the ARS-Arizona experiment station study, points out that a plant's responses to irrigation and fertilizer are interdependent. The plant has a natural tendency to develop its root system where it can get nutrients. In the loamy sand of the Yuma Mesa, that means deep. But the artificial supply of phosphorus put near the soil surface presumably causes the plants to alter their growth habit—to elaborate a root system near the surface. That calls for plenty of water in the surface soil. And when enabled to use top-level water, enriched with phosphorus, the plant gives a big return per inch of irrigation water applied.

The 500-pound plot was one of the most efficient in use of water. It required, on the average, less than 8 inches of water to produce a ton of hay on the well fertilized plots. Some dry, low-phosphorus plots needed twice as much water per ton of hay. Plots receiving about the same irrigations but more phosphorus were slightly more efficient. Also, the greater the water supply, the more efficient the water use.

At each phosphorus level, plots allowed to dry to the wilting point and then resoaked—5 inches each time, 68 inches per year—yielded the least hay and took the most water per ton. Plots watered more often—4 inches just before plants showed injury—used about the same total water, but did better. Plots given 2-inch irrigations at the sign of approaching dryness at the 12-inch depth did best: only 23 percent more total water nearly doubled yields per acre and per inch of water.☆

Wide-row corn makes NURSE CROP for forage mixtures

Corn may prove to be a good nurse crop for hay and pasture plantings.

Grass-legume mixtures seeded in extra-wide rows of Iowa corn last year grew well enough that ARS and State experiment station soil and water conservation specialists plan to continue the experiments.

Corn gave more profit per acre as a nurse crop than commonly used oats. The forage mixtures had to be seeded later in corn than in oats, however, and corn competed more severely with the grass-legume seedlings for soil moisture and plant nutrients.

Last year's tests emphasized this need for normal moisture if the forage-corn combination is to succeed. In three Iowa locations where the summer and early fall were extremely dry, the forage did poorly. At two other places where rainfall was nearer normal, grass-legume plantings made a good stand and grew rapidly.

Doubling the distance between rows (from 40 to 80 inches) lowered corn yields only 22 percent (from 94 to 73 bushels an acre) and gave the best forage growth. Weeds were easily clipped in the wide rows and didn't hamper the grass-legume mixture.

The scientists believe many farmers may switch from relatively low-profit oats to corn for establishing pasture and hay stands if further tests recommend corn as a nurse crop. Cover crops in corn would help control erosion and, turned under, provide organic matter and nitrogen.☆

SILT TRAPPED BY STUBBLE blew over from neighbor's field. Stubb mulch is the western rancher's greatest single device for holding s and water. But turning litter under, common in humid areas, l bare soil get hard—impervious to water—increases runoff, erosi

Mulch Farmin

DUST-DARKENED western skies and muddy spring freshets eastward of the Plains in 1954 solemnly reminded farmers to return to the ways of nature.

Those ways, say ARS soils-scientists, are the preserving of mulch on the land—working *with* mulch, raising crops *through* it, working the ground *under* it, but *never working it under*. Those scientists are determined today, as never before, to find practical ways of doing this.

Scientists and many farmers recognize mulch farming as one of the greatest techniques for holding soil—keeping it out of the sky, out of the river. And it is the greatest device for getting water into the soil and conserving it there—a critically important device in low-moisture areas, and an important, though not usually critical, one in the humid East. It has other values.

Stubble farming is a matter of grim necessity in the West, and is being increasingly practiced there. This year there was not enough mulch to hold the soil. Ironically, nature as well as man was at fault. Scant residues from the drought-injured crops of 1952–53 have made it difficult to keep the soil surface protected.

Adoption of mulch farming depends on how it affects yields, as well as its effect on land. It must be immediately practical. Farmers can't afford big sacrifices for future gain. Where mulch farming has been tried in humid areas, it has cut yield and caused other serious problems, largely offsetting the advantages. ARS and State experiment station scientists don't think this cut is inherent in mulch farming. They are concentrating on solving this problem—hope to unlock the tremendous potentialities of mulch farming within the next few years.

Scientists aren't sure why mulching frequently lowers yield in the humid region. A number of factors may be involved. Tie-up of nitrogen needed for plant food seems to be the greatest. Residue-decomposing organisms compete with crops for soil and fertilizer nitrogen. The larger the residue, the greater the nitrogen take. Organisms are most active at the beginning of the growing season. Ultimately the soil gets back this nitrogen plus some from the residue, but crops can't wait.

Feeding both crops and organisms with an extra supply of nitrogen is a possible solution. How much to use and where to place it—perhaps below the mulch zone to assure the crops' supply—are problems. More weeds under mulch farming are a big factor. Increased growth of weeds—robbers of moisture and plant food—calls for better controls through chemicals or tillage.

Reduction of the plant's ability to feed adequately on potassium appears to be another factor on some soils in the humid area. Mulch farming requires tillage which

SORGHUM STUBBLE on the Plains catches moisture for future. Modern tillage will make seedbed without disturbing stubble—save it to shelter young crop from blowing and drying out.

UNDISTURBED LITTER enables rainfall to soak in—not run off carrying soil away. The Ohio experiment station demonstrated this. After an hour's deluge—1 ¾ inches of rain per hour—soil mulched like this had only 1/20 as much water runoff in an April test and ⅕ as much in an October test as adjacent soil left without cover.

PRACTICE WITH A FUTURE

leaves residue on the surface—not moldboard plowing. When the surface 2 or 3 inches are worked the remainder may be compact and contain too little air. Where this condition exists, as in heavy soils, the lack of air lowers the plant's ability to feed on potassium.

Scientists feel that this potassium hunger can be overcome by improving the physical condition of the soil. Thorough tilling below the mulch—a difficult operation—or adding more potash fertilizer may help. Scientists aren't positive. More research is needed.

Other factors may be involved. Microorganisms may tie up phosphorus, like nitrogen. Residues may even favor undesirable organisms, rather than desirable ones. Then, too, germination is generally poorer under mulch.

Mulch tillage increases the rate of water absorption. This gives more water for the plant to draw on and is beneficial in dry seasons and dry areas. But on the heavy, slow-drying, slow-warming soils, mulching worsens the condition. Here the scientists recommend the application of crop residues or barnyard manure after getting the crop off to a timely start. This prevents later erosion and encourages water intake.

So mulch farming, useful though it is, still has serious limits. If these are overcome by research, mulching should take its place as a basic practice in agriculture.☆

SUBTILLAGE loosens the lower soil without disturbing the vetch mulch in this eastern field. Little mixing with soil means slow rotting and long life as a mulch. But soil under such a mulch will be slow in drying and warming up in the spring. So crops will be late.

DUCK-FOOT TILLER is being used to prepare this western stubble field for seeding wheat. It loosens the soil about 7 inches deep. Mulch and litter left near the surface will protect the soil against wind and water erosion while the new crop is getting established.

NEW VARIETY LEE, the first soybean aimed chiefly at disease control, gives South (shaded area) high resistance to bacterial pustule and wildfire, moderate resistance to target spot, and more tolerance than most other varieties to root-knot nematode. All are important in the South and among the top 10 soybean diseases. Lee also has high resistance to frogeye and purple seed stain. Bacterial pustule lesions provide an easy entry for wildfire bacteria, as well. The North lacks a variety with multiple resistance.

Lee originated from a cross made at Raleigh, N. C., 10 years ago by E. E. Hartwig, of ARS, working in cooperation with southern experiment station scientists. Several generations following the cross—a series of pollinations, tests, and selections of individuals—the F_6 descendants of a single plant became the foundation of the variety. Neither parent, S–100 or CNS, was outstanding, but jointly they gave Lee the desired superior characteristics.

Soybean

DISEASE BUILDS UP

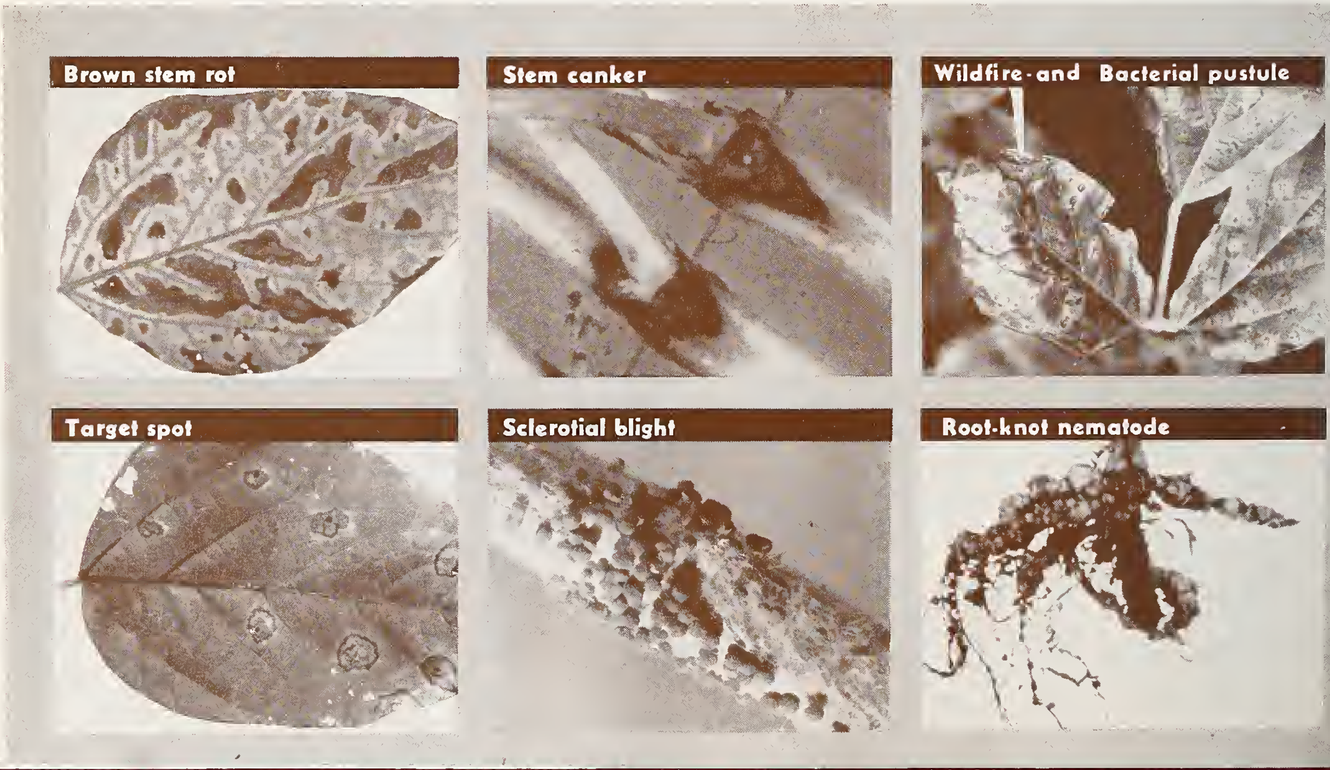
THE NEW SOYBEAN Lee, released to seed growers June 1, promises the South resistance to 4 of the Nation's top 10 soybean diseases. But the situation with the other 6 is far from encouraging.

Some 30 diseases—but chiefly the top 10—cost more than 12 percent of the crop. No adequate control is in sight for 3—brown stem rot and stem canker (which cause half the loss) and sclerotial blight—for a fourth, rhizoctonia root rot, no immediate control is in prospect.

This disease loss fulfills a prophecy of history: as a minor, trouble-free crop gets big, diseases build up. Paced by the rising vegetable-oils industry, soybeans expanded 9-fold in acreage and 12-fold in bean production in just two decades. They're now our fifth-ranking cash crop at $¾ billion a year.

The 10 big diseases rose from relative obscurity in a few years. Four were unknown a dozen years ago. Though it's 10 now and $100-million-a-year damage, it may soon

TOP 10 DISEASES of soybeans—7 of which are shown here—cause heavy damage yearly. Some, unnoticed a few years ago, are serious today. Most occur in a single region or part of it, but 2 occur in both. The top 10 are: *North Central States*—brown stem rot (found 1944), stem canker (identified 1948), frogeye, bacterial blight, bacterial pustule, wildfire (found 1943), and rhizoctonia root rot. *Diseases of the South*—bacterial pustule, wildfire, target spot (found 1945), sclerotial blight, and root-knot nematode.



be the big 20—even some unknowns—and far more loss.

As we get more dependent on soybeans and the disease threat deepens, teams of pathologists and agronomists in ARS and State experiment stations fight to get ahead of the diseases. Emphasis is on breeding for resistance. Several thousand distinct kinds of soybeans (genotypes) are tested yearly in search of resistance to the big 10 and other diseases, any of which may flare up.

Aside from Lee, several other varieties have adequate resistance for appreciable control of some diseases: *South*—Ogden, for pustule, wildfire, frogeye, and target spot; Dorman, for frogeye and downy mildew; Jackson, for frogeye, target spot, purple seed stain, and root knot; Roanoke, for frogeye and purple seed stain; and Acadian for downy mildew. *North Central States*—Flambeau and Hawkeye, for bacterial blight; Harosoy, for stem canker (but inadequate); Adams, Clark, Lincoln, and Wabash, for frogeye; and Chief and Dunfield, for downy mildew.

The important job is to get resistance for the 2 serious unchecked diseases (brown stem rot and sclerotial blight), improve resistance to the others (especially stem canker and rhizoctonia root rot), and develop for each area varieties resistant to all its major diseases.

We need to know more about the destructiveness of each disease—the true value of resistance to it. This would help growers decide whether to change to a resistant variety. It would also help scientists judge which diseases to give priority in their work—they have only estimates now. But ARS and experiment station plant breeders and pathologists are using a technique that will give a precise measure of loss, disease by disease:

A resistant soybean crossed with a susceptible one generally gives rise to plants of three kinds—some having only genes for resistance, some having only genes for susceptibility, and some (heterozygous ones) having genes for both. Heterozygous plants will give progeny of all three kinds. About eight generations following the cross the progeny of plants selected for the heterozygous condition for disease reaction will be essentially identical for all characters except disease reaction.

If the resistant and susceptible F_8 progeny are exposed to a disease, the difference in their bean and oil yield will accurately measure these effects of the disease. The scientists hope to study all major soybean diseases in this way as sources of resistance are found.

What can farmers do about soybean disease? They can use resistant varieties where available and adapted. They can turn under plant residues—sources of infection for future crops—and, if diseases are prevalent, rotate crops to prevent carryover of disease. And they can avoid planting diseased seed. In these ways they can take advantage of what science has already done for them.☆

PLANTING CORN at 5 miles an hour

Farmers may soon plant corn and put starter fertilizer in place for efficient use by the crop in a single operation at speeds as high as 5 miles an hour.

This isn't possible with equipment now commonly used, but it may come out of a 2-year cooperative study by ARS engineers, experiment-station scientists of 12 North Central States, and equipment makers.

Several developments stimulated the need for such a study. One of these was the growing use of large quantities of fertilizer on corn.

Another matter was the increasing power and speed of modern tractors—our planting and placement equipment just hasn't kept up. To use the greater capacity of tractors at top efficiency, they must either be loaded heavier or—what's equivalent to heavier loading—speeded up on light field work such as seeding.

In addition, research has brought out improved methods of fertilizer use that call for improved equipment.

In the study, starter fertilizers were drilled at seeding time in a single band about 2 inches to one side of the row at a depth ranging from seed level to 2 inches below. This gave as good results as placement with the common split-boot depositor 1½ inches to each side of the row at or above seed level.

At high speeds, the valves of conventional hill-dropping fertilizer machines must operate extremely fast. Drilling at only one side of the row enables engineers to simplify the makeup of the depositor. This, in turn, reduces operating troubles with the machinery.

Cooperating farm equipment manufacturers furnished the experiment station researchers several types of combination corn planters and fertilizer depositors of experimental design to try out in the study.

It was found possible to place fertilizer to one side and below the seed at the right depth—even at 5 miles an hour—when the depositor is properly designed. A split-boot depositor isn't built for the job.

The test equipment's performance records give implement manufacturers a basis for developing improved placement machines that will (1) operate at high speeds, (2) apply fertilizer more effectively, and (3) help farmers manage their work better—for example, by speeding up planting when the weather's right.

Studies were conducted in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, New York, Ohio, South Dakota, and Wisconsin.☆

Hybrid vigor for SORGHUM

PROFITING by an imperfection of Nature—male sterility in some grain sorghums—man may soon help Nature produce more of this crop.

In this case, male sterility (lack of pollen in the flower) may make hybridization as practical with grain sorghum as it has been with corn.

Male-sterile plants of the milo sorghum variety, Day, were found 2 years ago by plant breeder J. C. Stephens and associates in ARS-Texas experiment station research. This cytoplasmic male sterility was bred into several desirable kafir sorghum varieties, notably Combine 60. The male-sterile Combine 60, crossed with other varieties, produced hybrids yielding 25 to 30 percent above standard varieties. This compares well with corn-hybridizing experience.

Scientists are eyeing these hybrids in field tests for the first time in South Texas. If results are impressive, the male-sterile line will be planted by midsummer for seed increase, in hope of getting hybrids to farmers in 1956 or soon after.

Corn hybridization has been practical, commercially, because the male and female flowers (tassels and silks, respectively) are separated on the plant. Man can easily pull out the unwanted tassels—leave in the field only tassels of the desired male parentage. That prevents selfing and limits fertilization to crossing only. The seed breeder can choose the line or single-cross to grow for pollen and thus control hybridization.

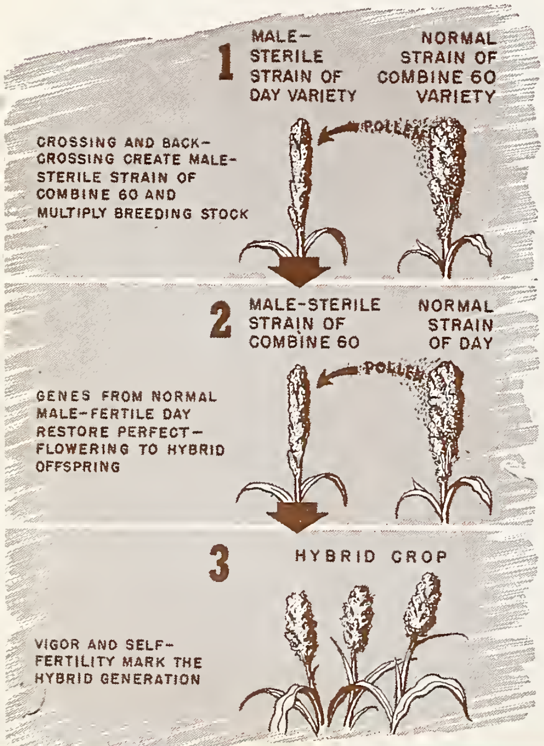
But sorghum produces the stamens (male) and pistils (female) together in the same flower. So it is impractical to remove pollen manually.

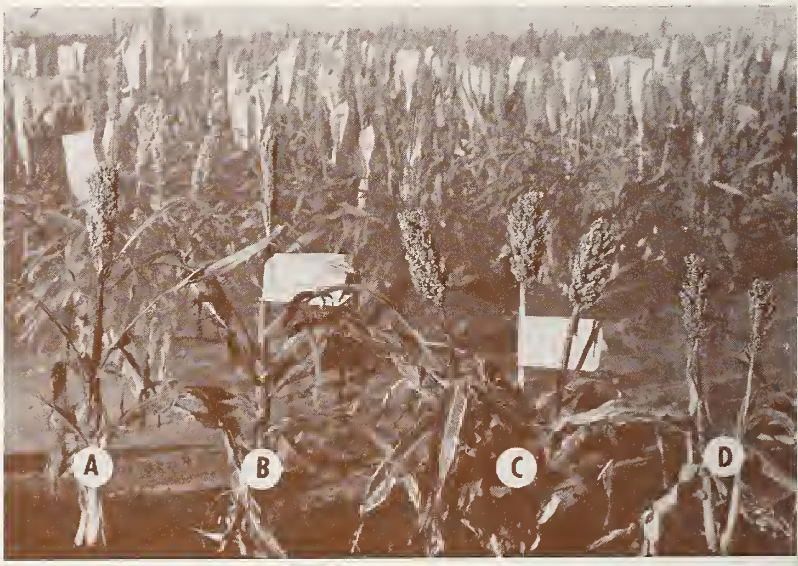
Seed is borne, of course, in the pistillate part of the plant. By nature, both self-pollination and cross-pollination commonly occur in perfect-flowered plants. But when the seed-bearing parent (female) is pollen-sterile, the pollen must necessarily come from a different plant—a pollen-perfect one. The basis of hybridization is, in fact, pollination of one plant by a plant of a different line, variety, or species.

This cytoplasmic type of sterility has been used lately in hybridizing corn (to eliminate hand-detasseling), onions, and other corps.

An important feature of hybridizing grain sorghum is that male sterility can be passed to various kafir varieties. But milo varieties restore fertility. So the new kafir strain is used as the female parent and a milo as the male to restore fertility—to endow the farm crop with hybrid vigor, perfect flowering, self-pollination, fruiting, and, it's hoped, considerably improved productivity.

Scientists in the Nebraska, Kansas, and Oklahoma experiment stations have also found male-sterile sorghums and are trying hybrid crosses.☆





KAFIR VARIETY Combine 60 set seed by normal self-pollination (A). Male sterile strain of Combine 60 set no seed when bagged (B), but produced vigorous hybrid (C) when pollinated by normal (male-fertile) Day variety (D). Hybrid had perfect flowers that pollinated themselves naturally and bore grain.

Safeguarding turkey's fine flavor

True flavor and fragrance of cooked turkey are so popular that any tinge of fishiness or other off-flavor in the meat is something growers are most anxious to avoid.

Reassurance to growers—and consumers as well—that antibiotics in turkey diets aren't likely to affect meat flavor comes from experiments conducted at the Agricultural Research Center, Beltsville, Md.

Antibiotics such as penicillin and terramycin are so effective in speeding the growth of young turkeys and chickens that almost all commercial starting feeds now contain one of these chemicals, says ARS poultry scientist Stanley Marsden.

(The most widely held view is that they kill off organisms that hinder full growth—based on the fact that germ-free chickens in laboratories grow surprisingly well and get no extra boost from antibiotics in their diet.)

For the ARS experiments, chlorotetracycline (Aureomycin) was chosen as typical of the widely used antibiotics. Beltsville Small White turkeys, fed experimental diets to various ages, were cooked and judged for eating quality under direction of food specialist Mary T. Swickard.

She found no differences in palatability between birds that got the antibiotic and those that did not.

Mrs. Swickard had a different report, however, on the flavor effects of too much fish products.

In recent years, ARS scientists have advised reducing fish meal and fish oil in turkey rations because research showed that fishy flavor was detectable in the cooked meat.

In the latest experiments, birds with and without antibiotic were fed reduced amounts of fish products. Even so little as 5 percent menhaden fish meal and 0.25 percent vitamin A and D fish oil caused dark meat and skin of roasted turkeys 14 and 16 weeks old to carry off-flavor.

(Birds of this age are commonly known as fryer-roasters. They are not much bigger than good-sized chickens and are just right, roasted or braised, for a home dinner. They're fast gaining in popularity.)

Growers marketing these young birds are now advised, as a result of the flavor experiments, to use no more than 5 percent of fish meal and to keep feeding oil to 0.15 percent or less for the starting diets.

Fish meal isn't absolutely essential in turkey feed. But it's valued because it furnishes, along with its good protein, an unidentified nutritional factor that's beneficial to the growth of the young birds.☆

Good frozen FRUIT PUREES are good for citrus industry

Frozen orange and lemon purees are now available as fresh-flavored fruit bases for use in desserts, bakery goods, and preserves.

Developed by the ARS Fruit and Vegetable Chemistry Laboratory in Pasadena, Calif., purees not only provide delicious bases for food products but also increase use of the citrus crop and lengthen the operating season for processing plants.

Oranges and lemons haven't previously been included among frozen fruit and berry purees, largely because it was thought they wouldn't keep well. The food trade has depended on concentrates, oils, or extracts for making citrus-flavored products.

In preparing the new purees, the whole fruit is crushed. It's reduced to puree consistency by passing it through a mechanically driven screening device that mixes as little air as possible into the product. Inedible parts are separated out. Dry sugar is then added (5 parts puree to 1 part sugar), and the puree is put in tin containers, frozen, and stored at 0° F. Yield of puree by this method is 50 to 60 percent of the whole fruit.

These fruit bases stay in good condition at 0° F. for more than a year, with little if any loss of the original vitamin C content.

Commercial production has met immediate success. The purees are also on the Army master menu.

Preservation of citrus purees by freezing has proved to be a highly efficient and economical method of preparing fruit bases with natural color, flavor, and nutritive value. Such purees can be used in a variety of foods—water ices, milk sherbets, sundae toppings, pastries, jams, jellies, marmalades, and fruit ades.

Purees have a distinct advantage for growers. Sound fruit of good flavor and color are suitable in spite of abnormal shape or size that makes them unfit for fresh market.

The new method also makes it possible for fruit-processing plants in certain citrus areas to do some processing throughout the year.

Research at the ARS Citrus Products Laboratory in Winter Haven, Fla., has shown that frozen purees can be successfully prepared from Florida-grown oranges and limes.☆

Saving alfalfa's carotene

Scientists call it 6-ethoxy-1, 2-dihydro-2, 2,4-trimethylquinoline. A manufacturer calls it Santoquin.

"It" is an antioxidant designed to preserve the carotene content of alfalfa meal. Commercial dehydrators who have applied the clear, light-yellow liquid to alfalfa meal call it a boon to the feed business.

Dehydrated alfalfa meal is an important constituent of manufactured feeds. Animal and poultry nutritionists have long known alfalfa as the most practical source of the carotene that the animal system converts to vitamin A, growth and reproductive factor. But they have found that, even under favorable weather conditions, field-cured alfalfa normally loses 50 to 75 percent of its carotene during the drying process. And carotene loss after storage for 6 months at 75 to 80° F. amounts to as much as 90 percent in sun-cured alfalfa.

Researchers learned many years ago that loss during harvest could be cut to 5 to 15 percent by immediate dehydration. But even dehydrated alfalfa also loses much of its carotene content during storage by combining with oxygen in the air.

Fortunately, fresh alfalfa is superabundantly blessed with carotene. The problem has been to devise an economical method of preserving approximately two-thirds of the original carotene content of the dehydrated meal from the time it's produced till it's fed—a period of 6 to 8 months.

Laboratory and large-scale field tests show that adding only about 5 ounces (0.015 percent) of Santoquin to each ton of dehydrated alfalfa meal accomplishes this purpose. Typical results show retention of about 65 percent of the meal's original carotene after 6 to 8 months storage at 75 to 80° F. Untreated meal stored under these conditions retains only about 25 percent of its carotene.

Roughly 60 percent of our dehydrated alfalfa meal goes into chicken and turkey feeds. Since a poultry ration contains only about 5 percent alfalfa, it's important for the carotene content to remain stable through the storage and feeding period.

Simple, inexpensive equipment has been designed to apply the antioxidant with vegetable oil or animal fat as a carrying agent. A number of alfalfa dehydration plants have adopted this or slightly modified versions. Approximately 25,000 tons of alfalfa meal was so treated in California during the 1953 season.

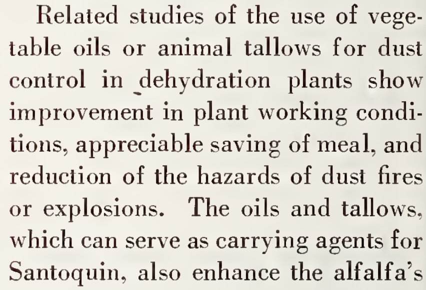
Toxicity tests at the Colorado experiment station revealed no drop in chick growth or egg production with poultry fed 100 times the normal amount of this antioxidant for a year. Tests on pigs and calves at the Illinois station showed no adverse effects from feeding several times the usual quantity. Studies on rats are in progress at the ARS Western Regional Research Laboratory.

This method of preserving alfalfa's carotene is the result of cooperation among government and university scientists and the dehydrating industry. A public-service patent has been issued to ARS chemist C. Ray Thompson and assigned to the Secretary of Agriculture.

Related studies of the use of vegetable oils or animal tallows for dust control in dehydration plants show improvement in plant working conditions, appreciable saving of meal, and reduction of the hazards of dust fires or explosions. The oils and tallows, which can serve as carrying agents for Santoquin, also enhance the alfalfa's green color.

It's estimated that dust control of all our dehydrated alfalfa meal would require (at the 1 percent level) 25 million pounds of fats annually. Similar use in all mixed feeds would take about 700 million pounds.☆

They can scratch lice away



Any cow will scratch to get rid of lice. ARS entomologists found that both beef and non-milking dairy cattle in Oregon experiments completely freed themselves of lice in 25 days—and kept themselves free of the pests during 30 more days of observation—when provided with an insecticide-treated rubbing device.

This consisted of a burlap-wrapped wire or cable stretched from the top of a 5-foot pole and anchored to the

ground 9 feet from the base of the pole. The cattle could readily scratch their backs, sides, and undersides on the slanting wire.

A similar device developed in earlier research by the South Dakota and Oklahoma experiment stations and USDA has proved popular with many livestock raisers as a good method of controlling hornflies.

In the first experiments for control of lice, carried out under feed-lot conditions, the rubbing device was not only effective but also safe—it was impossible for the cattle to get an overdose of insecticide by scratching on the wire. Researchers haven't yet determined if the device will work satisfactorily on the range. Chlordane was used on the burlap in the first tests. About a gallon of 5-percent chlordane oil solution was soaked into each delouser. Other insecticides are now being tried.

Entomologists believe this method of delousing cattle, if it proves out in continuing tests, may appeal to many northern farmers and ranchers who dislike spraying or dipping animals in cold or damp weather.☆

Beef and Pecans

GOOD SOUTHERN RECIPE

Beef cattle with pecans—like grits and gravy for breakfast—are turning out to be a natural combination in southern agriculture.

The secret of this team is adequate fertilization and proper management of good pasture mixtures—deep-rooted legumes, nutritious grasses—seeded in the pecan orchards.

Cooperative experiments by nut-tree specialists of ARS and the Georgia experiment station are showing that the right cover-crop species in the pecan orchards, if properly fertilized, will not only provide plenty of good grazing for beef cattle but also give higher yields of nuts.

In the Georgia trials, the output of Stuart pecan trees increased 88 percent over a 6-year period, compared with yields for the 6 years before fertilization and cattle grazing started. The output of Moore pecan trees under such fertilization and grazing increased 53 percent.

Weight gains of beef cattle in these orchards over a 3-year period amounted to 82 pounds per animal annually where the orchard was planted to small grain and vetch. In orchards where a crimson clover-Bermuda grass combination was used, the beef gain averaged 137 pounds per head annually over a similar period. All the seeded and grazed orchards were treated with phosphate-potash-rich 4–12–12 fertilizer applied at the rate of 500 pounds to the acre.

The cooperating researchers found reseeding crimson clover—used in combination with small grain, annual ryegrass, rescue grass, or Coastal Bermuda grass—highly desirable for planting in most pecan orchards.

This crimson clover, when properly handled, needs to be planted only once since it reseeds itself. It provides winter grazing as well as ground cover, and the Bermuda and other grasses furnish summer pasture. Grass that's not kept down by grazing is mowed, which provides a beneficial mulch for the pecan trees.

In some orchards, ladino or other white clovers, as well as hop clover, button clover, and Kenland red clover—combined with vetch or small grain—provide good early-spring grazing. But vetch, an annual crop plant, must be reseeded each year.

The researchers emphasize that best results are obtained only when all three recommended practices—(1) seeding a grass-legume mixture, (2) fertilizing, and (3) grazing—are followed. A Bermuda grass sod will steal both soil moisture and plant food from the pecan trees unless adequately fertilized and grown with a nitrogen-fixing legume. Grasses allowed to grow tall also put extra demands on the soil for moisture and nutrients. The pasture must be kept short by grazing or mowing to hold these demands down to a minimum.☆

PECAN ORCHARD, seeded to rye, vetch, and crimson clover and fertilized every fall with phosphate and potash, is giving these Georgia cattle lots of grazing, even during midwinter. Under such management, cattle make good gains and trees yield more nuts.

MICRO-INJECTION is fast way of putting disease organisms into test insects like this corn borer. Use of microscope helps insure accuracy.

Diseases can destroy INSECTS

ARS is stepping up its search for diseases that will destroy insects. Entomologists look hopefully to this field of basic research for help on the growing problems of insect resistance and toxic residues stemming from increased use of insecticides.

Residues would seldom be a problem in control of insects by disease because most insect diseases are harmless to man, animals, and plants. Furthermore, these diseases generally kill a single species without harming others; many insecticides kill both pests and beneficial insects.

Although disease is probably the least exploited of all control methods, entomologists see in recent successes evidence of a promising future:

Milky disease of Japanese beetles, developed by USDA and first used as a soil treatment in 1939, is now on the market throughout the beetle-infested East. The bacteria have been dusted over millions of acres to destroy the root-feeding grubs and halt the emergence of the foliage- and flower-feeding adult Japanese beetles.

Alfalfa caterpillar disease, developed by University of California scientists, was proved in the field in 1948. Since then, the virus has been used successfully by growers to control this alfalfa pest.

A virus spray brings on the newest promising disease for insect control. This disease was developed in Canada and used experimentally by USDA entomologists in 1951 against the European pine sawfly. Applications on New Jersey and Illinois pine stands gave excellent results.

To this vast and practically unexplored field of bacterial and virus diseases can be added many more diseases that are caused by equally important protozoan, nematode, rickettsia, and fungus organisms.

It has been less than two years since an insect-disease laboratory was established at the Agricultural Research Center, Beltsville, Md., under the leadership of S. R. Dutky. Work there has already uncovered many insect diseases not heretofore isolated and described. Three look especially promising: a virus disease of armyworms, a fungus disease that is lethal to several insects, and a bacterial disease of the pink bollworm.

The armyworm virus, under test in the field this summer, was collected during the 1953 armyworm outbreak in Maryland fields. The disease apparently spreads naturally and was an important factor in ending ravages of these pests in many areas.

The fungus disease was first noted in Russia in 1879 but has been studied little since then. Preliminary laboratory screening shows this fungus to be deadly to grubs of Japanese beetles, larvae of honey bees and wax moths, and adults of the Mexican bean beetle and the house fly. Mixing the disease with talc and puffing it over adult flies resulted in their death within 4 to 6 days. Honey bee larvae were killed in the laboratory in less than 24 hours, but the disease proved completely ineffective when tested at active bee-hive temperature.

Here's the plan the researchers follow in evaluating diseases of insects sent to the laboratory:

First, a diagnosis shows if disease is present. If so, it's isolated. Then, the disease is screened to find its effect on other insects. Finally, methods are developed for propagating sufficient quantities of promising diseases for large-scale testing.

Dutky has speeded up screening with a micro-injection technique (see picture). Incubation rooms help maintain and propagate the disease under controlled temperature and humidity. Even so, a number of laboratory problems still remain.

It must be kept in mind that such factors as temperature, moisture, and the life span of some of the organisms may limit their use for insect control. Unlike milky disease, which can be stored 13 years or more, many of the diseases are short lived. Others, like the fungus disease that kills bees in the laboratory but not in the hive, will have to be used when temperature and humidity are just right. Tests now underway may help us deal with a number of these problems.☆

WATER WAY FOR CHERRIES

WHEN Michigan's cherries ripen this year, some will move directly from orchard to cannery in large tanks of water. It looks as though this may be a better way of handling and transporting them than the slow, costly lug method that's now commonly used there.

Experiments in water-handling the cherries started in Michigan 2 years ago. USDA engineers, Michigan experiment station horticulturists, producers, and processors are cooperating in the research project.

Cherry canners have long followed the practice of cooling the fruit in water as soon as it arrives at the processing plant from the orchard. Initial experiments carried this idea further by transferring cherries at receiving stations from lugs to water tanks mounted on trucks.

So far, results strongly favor water-handling. The fruit arrives at processing plants in better condition than under lug-handling, sorting is easier and less costly, time and labor are saved in loading and unloading, and the need for a large stock of lugs is greatly reduced.

Experimental work included studies of the problems of cooling cherries and preventing damage. The relatively high temperatures of the fruit at picking, the time required for cooling to firm the flesh, and the quantity of water needed per ton of cherries all were considered. This led to development of suitable equipment, such as tanks, water distributors for the tanks, and flumes for unloading.

More than 400,000 pounds of cherries were moved last year from receiving stations to canners up to 250 miles away. To compare the methods, a similar quantity was moved in lugs under the same conditions.

This year, to hold top "tree quality," researchers will try eliminating all lug-handling by moving fruit directly from pickers' pails to a sorting belt, then to the tank truck.

Perhaps the method can be used for other crops as well as cherries.☆

LOADING cherries in truck-mounted tank filled with cold water helps cool fruit quickly, prevent bruising, retain more tree quality.

READY to go to plant. Circulating water has removed cherries' field heat. Researchers will spot tanks right in orchard this year.

UNLOADING cherries is simple job with use of labor-saving methods developed by horticulturist H. P. Gaston and engineer J. H. Levin.

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OFFICIAL BUSINESS

AGRISEARCH Notes

MORE: milk from crossbreds

Mating dairy cows to the best sires available—without regard to breed—offers dairymen an excellent way to increase the production efficiency of their herds.

Crossbreeding experiments by ARS dairy researchers over the last 15 years show that offspring of Holsteins, Guernseys, Red Danes, and Jerseys crossmated in various combinations give more milk than their purebred dams.

More than 50 two-breed cows, milked three times a day, produced an average of 13,039 pounds of milk and 586 pounds of butterfat in a year. A similar number of purebred cows averaged 10,540 pounds of milk and 455 pounds of butterfat. All were in their first normal lactation.

Carrying the crossbreeding a step further, the researchers found that three-breed cows produced even better than two-breed cows. The degree of improvement was much less, however, than that of two-breed animals over purebreds. Fifty-eight three-breed cows averaged 13,361 pounds of milk and 588 pounds of butterfat.

The procedure followed was to use sires of different breeds for the first and second crosses, then sires of the same breed as the original foundation cows. For example, Holstein cows were crossed with Jersey sires. The resulting Jersey-Holstein cows were bred to Red Dane sires, and the Red Dane-Jersey-Holstein females from this mating were bred to Holstein sires.

The order of breed rotation appeared to have an important effect only on the size of the animals of the new generation. The transmitting quality of the sires is the key to continued improvement.

ARS researchers recommend crossbreeding to dairymen who use an artificial breeding service and who are more interested in improving production efficiency than in maintaining breed lines. Several of the crossbred cows raised during the study proved satisfactory in the herds of cooperating commercial dairymen.

A detailed report of this study has been issued as USDA Technical Bulletin 1074, "A Crossbreeding Experiment with Dairy Cattle." Copies may be purchased at 45 cents each from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.☆

LESS: trouble from insects

Since 1945, greenhouse growers of flowers and vegetables have scratched 80 or 90 names off the list of insects that ruin blooms and fruit or cut production.

ARS development of DDT as an effective greenhouse insecticide marked the beginning of numerous pesticides—including phosphates and now systemics—for growers.

Aiding this success against the bugs has been the nearly simultaneous development of the aerosol by ARS researchers. Pest-killing that once involved several hours work by a spray crew, or even daylong fumigation, can now be handled as a routine end-of-the-day chore by one man with an insecticidal aerosol bomb.

Some flower pests that no longer cause serious damage in commercial greenhouses include mealy-bugs, scale insects, thrips, some aphids, leaf tiers, orchid weevils, orchid flies, rose midge, and chrysanthemum midge.

Greenhouse-rose production has jumped 25 to 40 percent since development of these methods. One grower increased output from 574,000 roses to more than a million in a year's time just by controlling insects.

Tomato and cucumber producers could add armyworms, cutworms, loopers, corn earworm, greenhouse whitefly, and tomato pinworm. Most tomato pests can be eliminated by 2 or 3 parathion aerosol applications while plants are in pots and another as first blossom clusters form.☆

U. S. GOVERNMENT PRINTING OFFICE: 1954